Chapter 10

Taxonomic and Ecological Observations on the Scorpions Collected in the Réserve Naturelle Intégrale d'Andohahela, Madagascar

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Abstract

An elevational transect of the scorpion fauna of parcel 1 and a general survey of parcel 2 in the Réserve Naturelle Intégrale d'Andohahela is reported. Six species of scorpions were collected in the reserve, including three in the humid forest of parcel 1 and three in the dry forests (spiny bush) of parcel 2. Although these two parcels are separated only by 20 km, their scorpion faunas contain no species in common. These collections yielded three species previously unknown to science, two of which have recently been described and the third of which is named here.

Résumé

Un "transect" altitudinal de la faune scorpionique de la parcelle 1, et un inventaire de celle de la parcelle 2 de la Réserve Naturelle Intégrale d'Andohahela sont rapportés dans ce travail. Six espèces de scorpions ont été collectées dans la réserve, trois d'entre elles dans la forêt humide de la parcelle 1 et trois dans les forêts sèches de la parcelle 2. Bien que ces deux parcelles soient séparées par seulement 20 km, leur faunes scorpioniques respectives ne présentent aucune espèce commune. Parmi les scorpions collectés, trois correspondaient à des espèces nouvelles, deux ont été décrites récemment et la troisème est décrite à présent.

Introduction

In recent years there has been increased interest in the scorpions of Madagascar (see Lourenço, 1996, for summary). Most of the scorpion material amassed on Madagascar to date has been the result of relatively random opportunistic collecting, however, and few sites have been surveyed systematically. The known scorpion faunas of individual sites are generally incomplete; this in turn hampers any detailed zoogeographical analysis of the island's fauna.

Methods

During the 1995 mission to the Réserve Naturelle Intégrale (RNI) d'Andohahela a collection of scorpions was made by S. M. Goodman, B. L. Fisher, and M. Pidgeon. Habitats sampled include the humid forests of parcel 1, within an elevational range of 400 to 1956 m, and the spiny bush of parcel 2, at 120 m (see Chapter 2). Although

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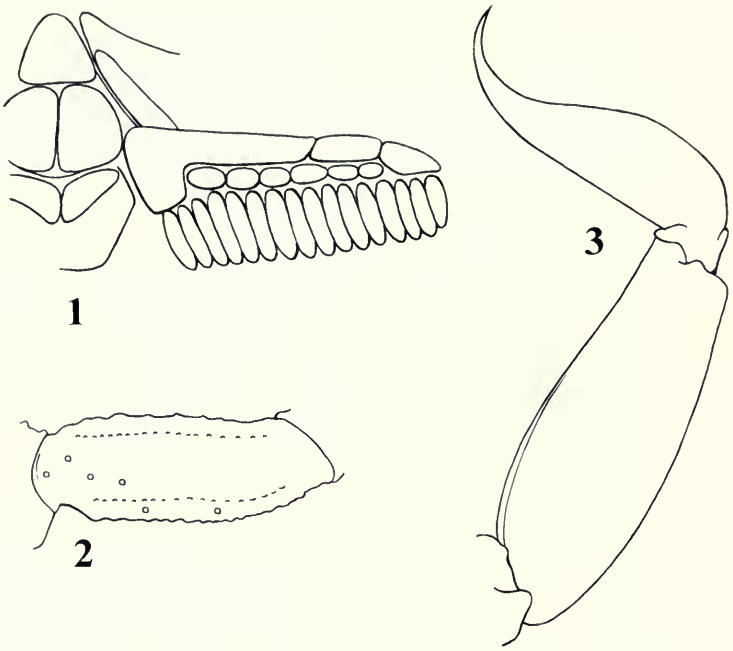

FIGS. 10-1 to 10-3. *Pseudouroplectes pidgeoni,* n. sp. Male holotype. (**1**) Sternum, genital operculum and pectine. (**2**) Femur, dorsal aspect, showing the A-α trichobothrial configuration. (**3**) Metasomal segment V and telson, lateral aspect.

we do not consider this collection to have been sufficiently exhaustive to reflect the complete scorpion fauna of the reserve, the use of systematic techniques at each site permits comparison of the results. Collection procedures in both parcels included pitfall buckets (see Chapter 12) and leaf litter sampling (Chapter 9). Furthermore, in parcel 2 active searching under fallen wood and rocks was also employed.

The first batch of material from the RNI d'Andohahela was sent to W. R. Lourenço while he was preparing a monograph on the scorpion fauna of Madagascar. On the basis of this material two species new to science were described (Lourenço, 1996). Since the publication of this work other specimens from the site have been studied. These include a representative of a third species new to science that is described here. Information is also provided on other records of scorpions from in and around the RNI d'Andohahela.

Results

Scorpions were collected from three of the six sites sampled in the RNI d'Andohahela: in humid forest in parcel 1, at 440 and 810 m, and in spiny bush in parcel 2, at 120 m. A total of six species were recorded, one of which is described below.

Pseudouroplectes pidgeoni Lourenço & Goodman, new species (Figs. 10-1 to 10-3)

HOLOTYPE (MALE)—Madagascar, Province de Toliara, Réserve Naturelle Intégrale d'Andohahela, parcel 2, 7.5 km E-NE of Hazofotsy, 46°36.6′E, 24°49′S, 120 m, between 7 and 15 December 1995, collected by M. Pidgeon. The specimen was in a soil litter sample at the edge of pitfall line 18. Deposited in the Field Museum of Natural History, Chicago.

ETYMOLOGY—It is with pleasure that we name this species after Mark Pidgeon, who collected the holotype during the 1995 expedition to the reserve. His participation in the mission and many years of field experience on Madagascar are gratefully acknowledged.

DIAGNOSIS—Very small scorpion, with a total length between 13 and 14 mm. The body is very slender and flattened. General coloration yellowish; presence of four longitudinal reddish brown stripes extending from the posterior margin of carapace to the keels of tergite VII. It may be

TABLE 10-1. Morphometric values of the male holotype of *Pseudouroplectes pidgeoni.*

Character	Measurement (mm)
Carapace	
length	1.7
anterior width	1.1
posterior width	1.6
Metasomal segment I	
length	0.9
width	1.0
Metasomal segment V	
length	2.1
width	1.0
depth	0.9
Vesicle	
width	0.5
depth	0.5
Pedipalp	
Femur length	1.2
Tibia length	1.7
Chelae length	2.2
Movable finger	
length	1.6

distinguished from *Pseudouroplectes betschi,* the first species described in this genus, by the presence of these four stripes, which are absent on *P. betschi.* The description is based on the male holotype, and measurements are presented in Table 10-1.

COLORATION—Prosoma and mesosomal dorsum yellowish, with four longitudinal reddish brown stripes that commence at the posterior margins of the carapace and extend over the tergites to the keels of tergite VII. Eyes surrounded with black pigment. Metasoma: all segments yellowish, with reddish brown pigment underlining the keels. Vesicle yellowish, without spots. Venter yellowish. Chelicerae yellowish without spots; fingers pale reddish. Pedipalps yellowish, with some vestigial reddish zones; fingers pale yellow, with reddish granulation. Legs yellowish.

MORPHOLOGY—Carapace with feeble but regular granulation; anterior margin with a very slight median concavity. Anterior median superciliary and posterior median keels very weak, only vestigial. All furrows not particularly pronounced. Median ocular tubercle distinctly anterior to the center; median eyes separated by slightly less than one ocular diameter. Three pairs of lateral eyes. Sternum subpentagonal to pentagonal. Tergites mesosoma feebly granular. Median keel moderate to feeble on all tergites. Tergite VII pentacarinate. Venter: genital operculum divided longitudinally. Pectines: pectinal tooth count 16–17; basal middle lamellae of the pectines not dilated; fulcra absent. Sternites smooth with short linear stigmata; VII without keels. Metasoma: segments I and II of metasoma with eight crenulate keels; segment III with six crenulate keels; segment IV with four crenulate keels; segment V with two vestigial keels. Ventral keels absent on all segments. Dorsal keels on segments I to IV with some posterior spinoid granules. Intercarinal spaces smooth. Telson smooth with a short and moderately curved aculeus and numerous setae. Cheliceral dentition characteristic of the family Buthidae (Vachon, 1963); ventral aspect of both finger and manus with dense fine setae. Pedipalps: femur pentacarinate; tibia and chelae with some moderately crenulate keels; internal face of tibia with some spinoid granules; all faces moderate to feebly granular. Movable finger of chela with seven linear rows of granules; accessory granules absent. Trichobothriotaxy, A-α (Vachon, 1973, 1975). Legs: tarsus with very numerous fine setae ventrally. Tibial spurs absent.

Known Scorpion Fauna of the RNI d'Andohahela

HUMID FOREST (PARCEL 1)—At 400 m in lowland humid forest the collections included nine specimens (all males) of *Heteroscorpion goodmani* Lourenço, 1996, family Heteroscorpionidae, and eight specimens (six males and two females) of *Grosphus madagascariensis* (Gervais, 1844), family Buthidae. These specimens were taken in a single pitfall line. A second pitfall line installed at 440 m yielded nine specimens (seven males and two females) of *Heteroscorpion goodmani* and five specimens (all male) of *Grosphus madagascariensis.* During the night numerous individuals of *H. goodmani* were observed with a standard flashlight on trunks of canopy trees within 2–3 m of the ground. Within the same elevational zone a single female specimen of *Tityobuthus parrilloi* Lourenço, 1996, family Buthidae, was collected in a leaf litter sample. At 810 m three specimens (two males and one female) of *Grosphus madagascariensis* were collected in the three pitfall lines. No scorpions were collected when these same devices were used within the 1200, 1500, and 1875 m zones. Furthermore, no scorpion was

obtained in the leaf litter samples from these three elevational zones.

Spiny Bush (Parcel 2)—Scorpions were relatively common in the spiny bush habitat of this parcel. The site surveyed was at 120 m, and all specimens were obtained within ±20 m. The individual collections included: (1) two specimens, one adult male and one immature male, of *Grosphus grandidieri* Kraepelin, 1901; (2) one male of *Grosphus grandidieri,* along with 14 specimens (10 males and four females) of *Opisthacanthus punctulatus* Pocock, 1896; (3) 13 specimens (seven males and six females) of *Opisthacanthus punctulatus,* which were collected under rocks and dead wood during the day; (4) 14 individuals (12 males and two females) of *Opisthacanthus punctulatus,* from under rocks; (5) eight specimens (three males and five females—juveniles), of *Opisthacanthus punctulatus,* from forest litter; and (6) one male specimen of *Pseudouroplectes pidgeoni* nov. sp., family Buthidae, in a litter sample.

Other Records from the Area

Several other records of the scorpion fauna of the region have been reported (Lourenço, 1996). These records include material obtained during the 1995 expedition to the RNI d'Andohahela and earlier collections from the reserve and neighboring areas. *Grosphus madagascariensis* was obtained 30–35 km NW of Fort Dauphin (Tolagnaro), Forêt d'Isaka (probably Isaka-Ivondro), in December 1901 by C. Alluaud. Furthermore, an immature male of this species and one female of *Tityobuthus parrilloi* Lourenço, 1996, were collected at 430 m along the northern boundary trail of parcel 1 on 24 November 1992 by B. L. Fisher. Finally, in this same region of the reserve but on slightly higher ground at 650 m, an immature male of *G. madagascariensis* was collected on 19 November 1992 by B. L. Fisher. *Opisthacanthus punctulatus* has been reported from parcel 2 at 46°36′E, 24°49′S (Lourenço, 1996).

Discussion

Among the specimens collected using pitfall buckets, males are dramatically more numerous than females. This is easy to explain, however, because male scorpions are much more active than females, particularly during the reproductive season. In general, scorpions reproduce during the rainy season (Lourenço, 1991, 1995). In the case of the RNI d'Andohahela, most of the scorpions were collected in the 440 m zone between 21 and 28 October 1995. During this 7 day period, 37.7 mm of rain was recorded. In southeastern Madagascar the actual start of the rainy season is variable between years and gradually commences during the month of October (Donque, 1975; Ratsivalaka-Randriamanga, 1985).

Table 10-2. The known scorpion fauna of parcels 1 and 2 of the RNI d'Andohahela.

Species	Parcel 1	Parcel 2
BUTHIDAE		
Grosphus grandidieri		120 m
Grosphus madagascariensis	400–810 m	
Pseudouroplectes pidgeoni		120 m
Tityobuthus parrilloi	430–440 m	
HETEROSCORPIONIDAE		
Heteroscorpion goodmani	400–440 m	
ISCHNURIDAE		
Opisthacanthus punctulatus		120 m
Total number of species	3	3

Four of the six males of *Grosphus madagascariensis* collected in the 400 m elevational zone had spermatophores in a final phase of ejection and ready for deposition over the substrate. This suggests that these males, in the presence of females, may have commenced some aspects of breeding courtship after they had fallen into the pitfall buckets.

On the basis of the collected material, the altitudinal and habitat characteristics of each species are relatively limited (Table 10-2). This is in accordance with the general pattern of scorpions having strict ecological requirements, with many classified as equilibrium species (Lourenço, 1991). The exception to this case is *Grosphus madagascariensis,* which was found in a broader range of elevations in lowland humid forest between 400 and 810 m, although within this altitudinal range the habitat is rather homogeneous. This species has a broad geographical range, including Nosy Be in the northwest, and it occurs throughout much of the eastern humid forests from the RNI d'Marojejy south to Tolagnaro (Lourenço, 1996).

The vegetation of parcel 1 is distinctly different from that of parcel 2, with the former being char-

acterized by its humid forest and the latter by its xerophytic bush. Between the two parcels, which are separated by an air distance of about 20 km, there is a remarkable change in the climate and flora across the rain shadow of the Anosyenne Mountains. Rain systems moving in from the eastern coast of Madagascar release their precipitation along the eastern slopes of the Anosyenne Mountains (Donque, 1972). This ecotone between wet and dry is known to be a major barrier to dispersal for certain groups of land vertebrates (see, e.g., Goodman et al., 1997). In the scorpion fauna no species is shared in common between the two parcels and faunal turnover is complete.

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